© 2014 IJEDR | Volume 2, Issue 1 | ISSN: 2321-9939

Palm Vein Authentication

[1]Purkar Rohini Uttam , [2]Sandbhor Ranjit Haridas , [3]Shinde Yogesh Durvas ,Amritkar Abhijeet Arun
Student
Computer Engineering, Government Collage of Engineering & Research Avasari, Pune, India
[1]rupurkarrohini@gmail.com, [2]ranjitsandbhor619@gmail.com, [3]yshinde353@gmail.com,
[4]amritkar.abhijeet25@gmail.com

***Abstract* -This paper represents an overview of palm vein authentication that uses blood vein patterns as personal identifying factor.The vein information is hard to duplicate since it is internal to the human body.The palm vein technology offers a high level of accuracy and delivers the following results :a false rejection rate(FRR) is of 0.01% and a false acceptance rate(FAR) is of 0.00008% or lower ,based on Fujitsu research using data of 140,000 palms.Compared to a finger or back of a hand ,a palm has broader and more complicated vascular pattern and thus contains the wealth of differentiating features for personal identification.**

I. INTRODUCTION

Biometrics are automated methods of recognizing a person based on a physiological or behavioral characteristic. Among the features measured are; face, fingerprints, hand geometry, handwriting, iris, retinal, vein, and voice. Biometric systems are superior because they provide a nontransferable means of identifying people not just cards or badges. The key point about an identification method that is ”nontransferable" means it cannot be given or lent to another individual so nobody can get around the system - they personally have to go through the control point. The fundamentals of biometrics are that they are things about a person: - measurable - things that can be counted, numbered or otherwise quantified - physiological characteristics - like height, eye color, fingerprint, DNA etc. - behavioral characteristics - such as the way a person moves, walks, types.

In a practical biometric system (i.e., a system that employs biometrics for personal recognition), there are a number of other issues that should be considered, including: Performance, which refers to the achievable recognition accuracy and speed, the resources required to achieve the desired recognition accuracy and speed, as well as the operational and environmental factors that affect the accuracy and speed; Acceptability, which indicates the extent to which people are willing to accept the use of a particular biometric identifier (characteristic) in their daily lives; Circumvention, which reflects how easily the system can be fooled using fraudulent methods. A key advantage of biometric authentication is that biometric data is based on physical characteristics that stay constant throughout one’s lifetime and are difficult (some more than others) to fake or change. Biometric identification can provide extremely accurate, secured access to information; fingerprints, palm vein and iris scans produce absolutely unique data sets (when done properly). Automated biometric identification can be done rapidly and uniformly, without resorting to documents that may be stolen, lost or altered. It is not easy to determine which method of biometric data gathering and reading does the "best" job of ensuring secure authentication. Each of the different methods has inherent advantages and disadvantages. Some are less invasive than others; some can be done without the knowledge of the subject; others are very difficult to fake . Palm vein authentication has a high level of authentication accuracy due to the uniqueness and complexity of vein patterns of the palm. Because the palm vein patterns are internal to the body, this is a difficult method to forge. Also, the system is contactless and hygienic for use in public areas. It is more powerful than other biometric authentication such as face, iris, and retinal. Palm vein authentication uses an infrared beam to penetrate the users hand as it is held over the sensor; the veins within the palm of the user are returned as black lines. Palm vein authentication has a high level of authentication accuracy due to the uniqueness and complexity of vein patterns of the palm. Because the palm vein patterns are internal to the body, this is a difficult method to forge. Also, the system is contactless and hygienic for use in public areas.[2]

II. PREVIOUS WORKS

Biometrics authentication is a growing and controversial field in which civil liberties groups express concern over privacy and identity issues. Today, biometric laws and regulations are in process and biometric industry standards are being tested. Automatic recognition based on “who you are” as opposed to “what you know” (PIN) or “what you have” (ID card). Recognition of a person by his body & then linking that body to an externally established identity forms a very powerful tool for identity management Biometric Recognition. Figure 1 shows the different type of biometric authentication. Canadian airports started using iris scan in 2005 to screen pilots and airport workers. Pilots were initially worried about the possibility that repeated scans would negatively affect their vision but the technology has improved to the point where that is no longer an issue. Canada Customs uses an iris scan system called CANPASS-Air for low-risk travelers at Pearson airport. Junichi Hashimoto, 2006, has introduced finger vein authentication, a new biometric method utilizing the vein patterns inside one’s fingers for personal identification. [2]
Vein patterns are different for each finger and for each person, and as they are hidden underneath the skin’s surface, forgery is extremely difficult. These unique aspects of finger vein pattern recognition set it apart from previous forms of biometrics and have led to its adoption by the major Japanese financial institutions as their newest security technology. [1]

III. 3.PROPOSED SYSTEM

Palm vein authentication system involves two modules 1st Enrollment, 2nd Recognition. Enrollment module involves acquisition of image, feature extraction, database creation. Recognition module have same block except instead of database block it have matching block which take data from database and decide whether user is authenticated .[4]

Image acquisition is of two type off-line and on-line. In image acquisition, we are using off-line images. On-line images are the images which are taken real time and off-line images means the images which are taken from already created database. We have taken CASIA ("Chinese Academy of Sciences Institute of Automation") Multi-Spectral Palm print Image Database V1.0 (or CASIA-MS-PalmprintV1 for short) for authentication purpose. Only 126 images are selected from the CASIA database which shows clear vein pattern.

For hand biometrics, multi-spectrum illuminator can penetrate subcutaneous tissues at different depths in palm regions and form images of both surface skin textures and hypodemia (including palm veins). Based on this property, they design a multi-spectrum imaging device to capture correlative and complementary information of human hands. All palm images are 8 bit gray-level JPEG files. For each hand, we capture two sessions of palm images. The time interval between the two sessions is more than one month. In each session, there are three samples. Each sample contains six palm images which are captured at the same time with six different electromagnetic spectrums. Wavelengths of the illuminator corresponding to the six spectrums are 460nm, 630nm, 700nm, 850nm, 940nm and white light respectively. Between two samples, we allow a certain degree of variations of hand postures. Through that, we aim to increase diversity of intra-class samples and simulate practical use.[8]

3.1 PRE-PROCESSING

3.1.1 ROI

In pre-processing we first find region of interest i.e. ROI. This is part of an image from where we get the maximum number of veins. This part of the image is taken for further pre-processing.

In order to account for the potential scale variations in the acquired contactless palm vein images, the location as well as the size of region of interest (ROI) are selected based on the instance between the two webs (LW) and is illustrated in the following equation

$$LD = \alpha LW$$

$$Lroi = \beta Lw \dots\dots \quad (1)$$

Where $LROI$ denotes the side length of ROI, LD denotes the distance between the ROI and the reference line, and LW represents the distance between the two webs, α and β are the factors that control respectively the location and size of the ROI.

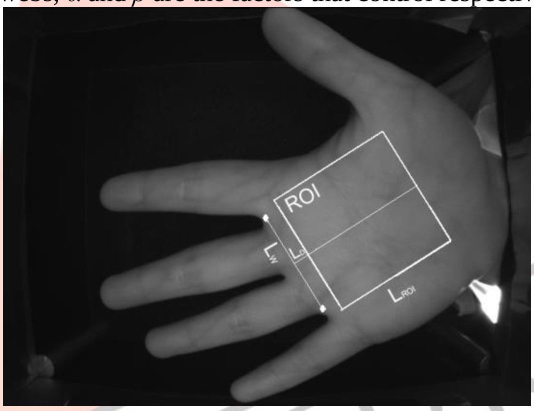

Figure: Robust segmentation of palm vein ROI from contactless images

3.1.2 CANNY EDGE DETECTOR

Canny's edge detection algorithm consists of the following basic steps:[5]

Step 1:

The first step is to filter out any noise in the original image before trying to locate and detect any edges. And because the Gaussian filter can be computed using a simple mask, it is used exclusively in the Canny algorithm. Once a suitable mask has been calculated, the Gaussian smoothing can be performed using standard convolution methods. A convolution mask is usually much smaller than the actual image. As a result, the mask is slid over the image, manipulating a square of pixels at a time. The larger the width of the Gaussian mask, the lower is the detector's sensitivity to noise. The localization error in the detected edges also increases slightly as the Gaussian width is increased.

Step 2:

The Sobel operator performs a 2-D spatial gradient measurement on an image. Then, the approximate absolute gradient magnitude (edge strength) at each point can be found. The Sobel operator uses a pair of 3x3 convolution masks, one estimating the gradient in the x-direction (columns) and the other estimating the gradient in the y-direction (rows). They are shown below

-1	0	+1
-2	0	+2
-1	0	+1

G_X

+1	+2	+1
0	0	0
-1	-2	+1

G_Y

The magnitude, or edge strength, of the gradient is then approximated using the formula:

Step 3:

The direction of the edge is computed using the gradient in the x and y directions. However, an error will be generated when sum X is equal to zero. So in the code there has to be a restriction set whenever this takes place. Whenever the gradient in the x direction is equal to zero, the edge direction has to be equal to 90 degrees or 0 degrees, depending on what the value of the gradient in the y-direction is equal to. If GY has a value of zero, the edge direction will equal 0 degrees. Otherwise the edge direction will equal 90 degrees. The formula for finding the edge direction is just:

Theta = $\tan^{-1}$ (Gy / Gx)

Step 4:

Once the edge direction is known, the next step is to relate the edge direction to a direction that can be traced in an image. So if the pixels of a 5x5 image are aligned as follows:

x x x x x
x x x x x
x x a x x
x x x x x
x x x x x

Then, it can be seen by looking at pixel "a", there are only four possible directions when describing the surrounding pixels - 0 degrees (in the horizontal direction), 45 degrees (along the positive diagonal), 90 degrees (in the vertical direction), or 135 degrees (along the negative diagonal). So now the edge orientation has to be resolved into one of these four directions depending on which direction it is closest to (e.g. if the orientation angle is found to be 3 degrees, make it zero degrees). Think of this as taking a semicircle and dividing it into 5 regions. Therefore, any edge direction falling within the yellow range (0 to 22.5 & 157.5 to 180 degrees) is set to 0 degrees. Any edge direction falling in the green range (22.5 to 67.5 degrees) is set to 45 degrees. Any edge direction falling in the blue range (67.5 to 112.5 degrees) is set to 90 degrees. And finally, any edge direction falling within the red range (112.5 to 157.5 degrees) is set to 135 degrees.

Step 5:

After the edge directions are known, non-maximum suppression now has to be applied. Non-maximum suppression is used to trace along the edge in the edge direction and suppress any pixel value (sets it equal to 0) that is not considered to be an edge. This will give a thin line in the output image.

Step 6:

Finally, hysteresis is used as a means of eliminating streaking. Streaking is the breaking up of an edge contour caused by the operator output fluctuating above and below the threshold. If a single threshold, T1 is applied to an image, and an edge has an average strength equal to T1, then due to noise, there will be instances where the edge dips below the threshold. Equally it will also extend above the threshold making an edge look like a dashed line. To avoid this, hysteresis uses 2 thresholds, a high and a low. Any pixel in the image that has a value greater than T1 is presumed to be an edge pixel, and is marked as such immediately .Then, any pixels that are connected to this edge pixel and that have a value greater than T2 are also selected as edge pixels. If you think of following an edge, you need a gradient of T2 to start but you don't stop till you hit a gradient below.

3.1.3 THINNING

After edge detection if edges are thick then thinning is used. Thinning is a method which convert image into a single pixel value.

The thinning of a set A by a structuring element B, denoted as following equation can be defined in terms of the hit-or-miss transform.

Thinning:

$$\begin{aligned} A \otimes B &= A - (A \circledast B) \\ &= A \cap (A \circledast B)^c \end{aligned}$$

3.1.4 FEATURE EXTRACTION

"One of the most interesting aspects of the world is that it can be considered to be made up of patterns. A pattern is essentially an arrangement. It is characterized by the order of the elements of which it is made, rather than by the intrinsic nature of these elements". This definition summarizes our purpose in this part is called as feature extraction. This step is responsible of extracting the patterns of the veins taking into account the correlation between adjacent pixels. We are using a Haar wavelet transform. Wavelet transform is easier to compress, transmit and analyze any image. Wavelet transform are based on small waves called wavelet, of varying frequency and limited duration. Digital images require large amounts of memory to store and, when retrieved from the any device, can take a considerable amount of time to download. The Haar wavelet transform provides a method of compressing image data so that it takes up less memory. [5]

FORMULA:

Haar transform van be expressed in the following matrix form

$T=HFH^T$
Where F is N×N image matrix
H is N×N Haar Transform matrix which contains the HAAR basic functions hk (z)
T is resulting N×N transform
Transpose is required because H s not symmetric.

For k= 0, 1, 2, 3…. N-1 Where $N=2^n$
$K=2^p + q-1$ Where $0 \leq p \leq n-1$ q=0 or 1, for p=0
And $1\leq q\leq 2^p$ for $p\neq 0$

The Haar Basis Functions are
$H_0 (z) =h_{00} (z) =1/\sqrt{N}, z \in [0, 1]$ …………………… (1)
And
$H_k (z) =hpq (z) =1/\sqrt{N} (2^{(p/2)})$ for $(q-1)/ (2^p) \leq (q-0.5)/ (2^p)$
$=1/\sqrt{N} (-2^{(p/2)})$ for $(q-0.5)/ (2^p) \leq q/ (2^p)$
$= 0$ Otherwise, $z\in [0, 1]$

Image compression using the Haar wavelet transform can be summed up in a few simple steps.

1. Convert the image into a matrix format (I).
2. Calculate the row-and-column transformed matrix (T) using $T = W^T I W$. The transformed matrix should be relatively sparse. Where S is an N × N image matrix, W is an N×N Haar transformation matrix, and T is the resulting N × N matrix.
3. Select a threshold value ϵ, and replace any element of T less than ϵ with a zero. This will result in a sparse matrix denoted as S.
4. To get our reconstructed matrix R from matrix S, we use an equation similar to $I = (WT)^{-1} T W^{-1}$, but, because the inverse of an orthogonal matrix is equal to its transpose, we modify the equation as follows:
$$R = WSW^{-1}$$
5. If ϵ = 0, then S = T and therefore R = I. This is called lossless compression.
6. If ϵ > 0, then elements of T are reset to zero, and some original data is lost. The reconstituted image will contain distortions. This is called lossy compression.
7. The secret of optimal compression is to choose ϵ so that compression is maximized while distortions in the reconstituted image are minimized.
8. The level of compression is measured by the compression ratio, which is the ratio of nonzero entries in the transformed matrix T to the number of nonzero entries in the compressed matrix S a compression ratio of 10 : 1 or greater means that S is sparse enough to have a significant savings in terms of storage and transmission time.

Thus from this we remove the unwanted data and store the unique feature of an image.

3.1.5 PATTERN MATCHING

To recognize an image means to check whether the image exist in the database. When a person wants to get access to the system, the picture of the vein, known as the test image is captured. The coordinates of the test image are obtained and represented as the training set. The weight of the new image is calculated and projected on the vein space. The vein space contains all the vein images. Thus, we have to check whether the input image exist in that space. The Euclidean distance between the projected image and those stored is being calculated. First of all, our system checks whether the test image is a vein by testing it with an arbitrary value. Then the Euclidean distance is computed to check whether the test image exist in the database. If it is vein image, then it is accepted.

Euclidean Distance: [8]

The Euclidean Distance between a pixel vector z and an arbitrary point a in n-dimensional space is defined as the vector product

$D (z, a) = [(z-a)^T (z-a)]^{(1/2)}$ ……………………generalized 2D Euclidean Distance
$= [(z_1-a_1)^2 + (z_2-a_2)^2 + …. + (Z_n-a_n)^2]^{(1/2)}$...Vector Norm

REFERANCES

[1] Debnath Bhattacharyya, Poulami Das, Tai-hoon Kim, Samir Kumar Bandyopadhyay, "Vascular Pattern Analysis towards Pervasive Palm Vein Authentication" Journal of Universal Computer Science, vol. 15, no. 5 (2009), 1081-1089 submitted: 1/8/09, accepted: 28/2/09, appeared: 1/3/09 © J.UCS.

[2] Shi Zhao1, Yiding Wang2 and Yunhong Wang3, "Extracting Hand Vein Patterns from Low-Quality Images: A New Biometric Technique Using Low-Cost Devices", Fourth International Conference on Image and Graphics.

[3] [Ding, 05] Yuhang Ding, Dayan Zhuang and Kejun Wang, "A Study of Hand Vein Recognition Method", The IEEE International Conference on Mechatronics & Automation Niagara Falls, Canada, July 2005, pp. 2106-2110.

[4] [Jain, 04] Anil K. Jain, Arun Ross and Salil Prabhakar, "An Introduction to Biometric

[5] Recognition", IEEE Transactions on Circuits and Systems for Video Technology, Vol. 14, No.1, January 2004, pp. 4-20.

[6] Toshiyuki Tanaka, Naohiko Kubo, "Biometric Authentication by Hand Vein Patterns", SICE Annual Conference, Sapporo, August 4-6, 2004, pp. 249-253.

[7] http://biometrics.idealtest.org

[8] MathWorks homepage http://www.mathworks.com\
[9] Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education , third edition 2009.